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Team demonstrates, validates portable laser coating removal system

by Timothy R. Anderl, AFRL Materials and Manufacturing Directorate

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — A team from the Air Force Research Laboratory (AFRL) and Air Force Materiel Command (AFMC) is demonstrating and validating commercially available, portable handheld lasers for coating removal. The process will be used to supplement existing depainting processes in an effective, environmentally safe manner.

The technology demonstration and validation program, part of the Joint Group on Pollution Prevention (JG-PP) process, is a partnership between various government organizations to validate and implement cleaner and cheaper processes at military and industrial facilities. The technology will be used by maintenance technicians at depots and Air Logistics Centers (ALCs).

AFRL's Pollution Prevention Research and Development Team (MLSC) and AFMC's Logistics Environmental Branch (LGP-EV) contributed technical and programmatic expertise to the effort, which is funded by the Environmental Security Technology Certification Program (ESTCP) and AFMC's Pollution Prevention Integrated Product Team, numerous Air Force weapon system programs, all of the Air Force ALC, the Army, Marines, Navy and the National Aeronautics and Space Administration (NASA).

Commercial and military aircraft frequently need to be paint-stripped to allow for inspection, maintenance, and nondestructive evaluation work. Off-the-shelf pulsed lasers, which are finding increased use in today's commercial operations to clean and de-coat a variety of materials, will offer significant benefits as a non-abrasive coating removal process. Currently, removing coatings requires using hazardous materials that generate large amounts of hazardous waste and pose a significant occupational health risk for workers performing this task. The Air Force expects large savings by eliminating or minimizing chemical purchases, their use and associated waste streams.

Pulsed lasers work by emitting a series of brief energy bursts while aimed at the surface of a coated material. As the energy is applied, the laser removes coating that has been applied to the material. On aircraft materials, the laser may be used to remove multi-layered paints, primers, or other special coatings. The process is repeated until the desired depth is reached, and can be tailored to strip at a specific depth to remove single layers of coating or paint while others remain intact.

"These lasers have proven useful in a variety of commercial arenas," said Thomas Naguy, the AFRL Materials and Manufacturing Directorate's (ML) team leader for the project. "So AFRL leveraged manpower and funding resources to identify this Air Force technology need, prototype the technology and begin working with our customers to fully implement the technology."

Harold Hall, a technician from ML's LHMEL facility, demonstrates the Carbon Dioxide laser by stripping a substrate coated with an Air Force JTP-approved coating. (Air Force photo)

The prototype for this project was started in 1998, based on requirements developed by the Environmental Safety and Occupational Health Technology Integrated Product Team, now the Environmental Development Planning Team. In 2000, AFRL and AFMC teamed to identify the prototype technology, and to begin the demonstration, validation and technology transition process based on a Joint Test Protocol (JTP), which is a

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set of requirements used to qualify available commercial-off-the-shelf systems to meet joint service and NASA needs.

"One of the successes of this project was that we were able to competitively leverage AFRL resources and technical skills for the demonstration and validation phase of the project," Naguy said. "When four laser technologies were selected for demonstration and validation, ML technicians from the Survivability and Sensor Materials Division's Laser Hardened Material Evaluation Laboratory (LHMEL) began demonstrating their operational capabilities."

Technicians from LHMEL will demonstrate two Neodymium Yttrium Alumina Garnet (ND:YAG) laser cleaning machines capable of producing 120 watts of average power, a diode laser with power capabilities reaching to 250 kilowatts average power, and a Carbon Dioxide (CO_2) laser with an average power of 520 watts.

ML's Logistics Systems Support Branch Coatings Technology Integration Office (CTIO) lent additional support to the effort by preparing specimens for testing, and assuming responsibility for coating and recoating materials. Materials samples they prepared, which included various substrate types including aluminum, Kevlar, fiberglass epoxy, and alloy steel, were coated with Air Force and Army paints as specified by the JTP. Additional testing, including substrate damage assessment and measuring temperature affects, was also conducted.

After a four-cycle strip and repaint process is conducted on the specimens, ML's Acquisition Systems Support Branch will conduct mechanical testing, including tensile and fatigue testing to characterize the laser's effects on the substrate.

Testing for this phase of the project will be completed by 2003, and the final procurement specification and technical order is anticipated to be complete by 2005. Currently, AFMC is creating a technical order, which will address laser operation and safety in the field.

"We are convinced that lasers are the wave of the future," Naguy said. "By teaming with AFMC, ESTCP and our stakeholders to successfully undertake this customer-driven project, we were successful in leveraging resources (both manpower and funds), properly identifying requirements, identifying the prototype technology, and working with customers to demonstrate, validate, and transition a safe and timely laser technology to technicians in the field." **@**